United Nations E/HLPF/2017/4

Economic and Social Council

Distr.: General
31 May 2017

Original: English

High-level political forum on sustainable development
Convened under the auspices of the Economic and Social Council
10-19 July 2017

Multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals*

Note by the Secretariat

The President of the Economic and Social Council has the honour to transmit to the high-level political forum on sustainable development the Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals, held in New York on 15 and 16 May 2017. The Co-Chairs of the forum, the Permanent Representative of Kenya to the United Nations, Macharia Kamau, and the Science and Technology Adviser to the Secretary of State of the United States of America, Vaughan Turekian, were appointed by the President of the Council. The summary is being circulated pursuant to paragraph 123 of the Addis Ababa Action Agenda (General Assembly resolution 69/313) and paragraph 70 of the 2030 Agenda for Sustainable Development (Assembly resolution 70/1).

* The multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals concluded on 16 May 2017. Adequate time was required for the drafting, consulting and clearance of the draft summary by the Co-Chairs, taking into consideration the Memorial Day holiday in the intervening period.

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Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

I. Introduction

1. The present summary represents a reflection of the broad discussion that took place during the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals. The summary captures the spirit of the discussions that took place during plenary and breakout sessions. As such, it provides a diverse set of opinions articulated through both formal and informal statements provided by stakeholders. The views expressed in the present document do not necessarily represent opinions held or endorsed by the co-chairs or the Governments they represent.

2. Pursuant to General Assembly resolution 70/1, on 15 and 16 May 2017, the President of the Economic and Social Council, Frederick Musiiwa Makamure Shava, convened the second annual multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals. As a component of the Technology Facilitation Mechanism, the forum is a venue to discuss cooperation in science, technology and innovation around thematic areas pertaining to the implementation of the Sustainable Development Goals, bringing together all relevant stakeholders to actively contribute in their areas of expertise. The forum provides a venue for facilitating interaction, matchmaking and the establishment of networks between relevant stakeholders and multi-stakeholder partnerships in order to identify and examine technology needs and gaps, including with respect to scientific cooperation, innovation and capacity-building, and to help to facilitate the development, transfer and dissemination of relevant technologies for the Goals.

3. The Permanent Representative of Kenya to the United Nations, Macharia Kamau, and the Science and Technology Adviser to the Secretary of State of the United States of America, Vaughan Turekian, co-chaired the forum. The forum was prepared by the United Nations inter-agency task team on science, technology and innovation for the Sustainable Development Goals, with the support of the 10-member group of high-level representatives from civil society, the private sector and the scientific community. The President of the General Assembly, Peter Thomson, and the Assistant Secretary-General for Policy Coordination and Inter-Agency Affairs made statements at the opening of the forum.

4. The forum was well attended, with almost 800 participants representing 90 Governments and more than 390 scientists, innovators, technology specialists, entrepreneurs and civil society representatives — a broader participation than in 2016. The forum comprised interactive sessions that provided adequate time for discussion among all stakeholders. Pursuant to its mandate, the forum promoted networking and matchmaking, including through an exhibition hub of innovators, online discussions, 25 side events and other special events.

II. Highlights of the discussions at the forum

5. The forum deliberated on the challenges and technology solutions with transformative impact on each of the six Sustainable Development Goals that are up for review at the high-level political forum in 2017: Goals 1, 2, 3, 5, 9 and 14. In particular, it explored options for enhanced poverty eradication through science, technology and innovation solutions (Goal 1); technology needs and gaps,

cooperation priorities and the implications of new agricultural technologies (Goal 2); priorities for engaging science, technology and innovation for ensuring healthy lives and promoting well-being for all at all ages (Goal 3); the role of science, technology and innovation for achieving gender equality and empowering all women and girls (Goal 5); and gaps and opportunities for science, technology and innovation related to oceans, maritime resources and human systems that depend on them (Goal 14). The forum also examined what the global community could do to address the current scientific and technological challenges faced by developing countries, on the basis of lessons learned from adopting advanced technologies and infrastructure (Goal 9). The forum addressed cross-cutting issues, including a long-term vision on science, technology and innovation for the Goals; science-advisory systems in foreign ministries; national science, technology and innovation plans and policies; capacity-building; emerging technologies; resources for science, technology and innovation scale-up; and next steps for the Technology Facilitation Mechanism. In the remainder of this section, selected messages and highlights of the forum are summarized.

Harnessing science, technology and innovation for the Sustainable Development Goals and for ending poverty in all its forms everywhere (Goal 1)

6. Science, technology and innovation policies are essential for eradicating poverty and achieving health and well-being, in line with the aspiration contained in the 2030 Agenda for Sustainable Development to "leave no one behind". Economic growth is essential to poverty eradication, but growth must also be both environmentally sustainable and socially inclusive. Science, technology and innovation policies should seek to promote this balance. In this regard, all stakeholders should pay more attention to basic technological development in many countries, taking into account the needs, capabilities and realities of vulnerable groups. Bridging achievement gaps between population groups will also strengthen innovation systems, which rise and fall in line with the level of social acceptance, thereby reducing costs, increasing quality, improving overall productivity and ultimately leading to long-term economic growth. Against this background, it is important to put in place policies that help translate increased efficiency in production into job creation.

7. Integrated and systemic approaches to poverty eradication can benefit from coordination, collaboration and communication among all policymakers. Breaking institutional silos is essential in this regard, but can be difficult, owing to conflicting interests.

8. National science, technology and innovation and sustainable development policies should be designed to strengthen linkages among actors in national innovation ecosystems, ensuring that research and development are targeted at national priorities. Science, technology and innovation policies and processes should support hands-on learning and other practical educational experiences to inspire interest among future science, technology and innovation practitioners. In this regard, capacity-building efforts should be focused on youth.

9. Science, technology and innovation derive from diverse sources of knowledge. These diverse sources should be considered and assessed in the development of technology solutions to sustainable development challenges and in the promotion of evidence-informed decision-making. Governments should consider creating national expert panels, consisting of scientists, engineers and other respected individuals, to provide expert knowledge to local efforts for implementing the Sustainable Development Goals.

10. Partnerships are crucial for the development and adaptation of low-cost technologies in order to ensure the widest possible diffusion of technology and

beneficial impact on individual livelihoods. Affordable Internet access (especially in the "last mile") is a limiting factor for innovation acceleration and technology diffusion.

Science, technology and innovation for ending hunger, achieving food security and improved nutrition and promoting sustainable agriculture (Goal 2)

11. It is important to create strong linkages between scientists and farmers, in particular smallholders. All stakeholder inputs, including inputs from smallholder farmers, should be included in science, technology and innovation policies for agricultural development through better participatory approaches, recognizing the important potential contribution of local practices.

12. Although science, technology and innovation have contributed to steep declines in malnourishment, 800 million people around the world remain malnourished. Inclusiveness and sustainability are important for successful science, technology and innovation strategies for achieving food security. Collaboration among the critical actors in the agricultural system is fundamental to eradicating hunger and increasing food security. Governments, public institutions, private sector enterprises, development partners and non-governmental organizations must strengthen collaborative linkages among themselves to promote science, technology and innovation in agriculture and food systems. Youth participation in agriculture is paramount in improving food and nutrition security, and thus incentives for youth engagement should be considered, as appropriate in each national context.

13. Greater investment is needed in research, human capacities for agricultural science, technology and innovation, and rural infrastructure. Seed and gene banks can make a significant contribution in this regard. In this context, it is important to recognize that international property rights can contribute positively to an enabling environment that promotes sustainable development for smallholder farmers.

14. New technologies can potentially address sustainable development challenges in rural economies by opening up new markets for products. This could promote food security around the world, while improving economic well-being for rural communities. In this vein, it will be important to carefully examine the potential of hybrid crops, biofortification, genome editing, big data, satellite imagery and predictive analytics. Highly resilient hybrid crops can increase yields. Biofortification can make crops more nourishing. Genome editing can contribute to developing plants that are more resistant to diseases and grow more rapidly. Financing agricultural innovations and putting in place policies to facilitate the widest possible diffusion of such innovations is an important factor in creating an ecosystem of continuous innovation. In this regard, science, technology and innovation funding mechanisms should be continuously reviewed to ensure they are adequately promoting improved access, availability and effectiveness of innovations.

15. Innovations in data science can guide policy and improve farm production and efficiencies in agricultural practices. Data analytics can help agricultural markets in developing countries by prompting discoveries and the development of more resilient or higher yielding crop varieties and in anticipating famines or other situations that result in food insecurity. In this regard, there is a need for greater international collaboration in sharing data and knowledge. During the forum, young social entrepreneurs presented their digital solutions to connect smallholder farmers with marketing and advisory services.

Science, technology and innovation for ensuring healthy lives and promoting well-being for all at all ages (Goal 3)

16. Interconnections between Goal 3 and the other Goals are complex, as health issues are related to environmental and socioeconomic issues. For example, progress in ensuring universal access to modern energy sources reduces household air pollution and allows the storage of vaccines. All stakeholders should address the interconnections among Goals in a holistic manner, focusing on interconnections and identifying synergies to accelerate the implementation of multiple goals. For example, clean cookstoves and cold storage for vaccines are two areas in which the issues of energy and health can have synergies.

17. Human intrusion into animal habitats has contributed to the spread of infectious diseases, with more than half of emerging infectious diseases spread by animals. Against this backdrop, a holistic "One Health" approach supported by multidisciplinary research across borders would be beneficial. Such an approach requires training for medical staff, veterinarians and epidemiologists so as to carry out multisectoral surveillance to detect early signs of outbreaks and implement effective preventive measures. This is especially important in view of continued urbanization, as a greater density of people, especially in informal urban settlements, facilitates the spread of disease.

18. All stakeholders should strengthen linkages between science and societies to reframe the question around the problems to be solved, to develop local research capacities, to mobilize financing and to establish partnerships that facilitate the development of local innovation capacities. It is important to support the participation of local communities in the co-creation of innovations, which can help in identifying unaddressed needs, to develop simple and affordable solutions sensitive to the local context.

19. Governments should ensure appropriate public policy frameworks and set policy goals. Such responses signal priorities to the private sector and innovators, and help the private and the public sectors to work together to synthesize innovation and knowledge from all sectors, for the implementation of the Sustainable Development Goals. Governments should also create regulatory environments conducive to fostering innovation and entrepreneurship, so that entrepreneurs can mobilize resources for resolving bottlenecks in health challenges.

20. New innovation paradigms related to microelectronics, nanotechnology, fine chemicals, biotechnology and information technology are emerging in the health sector. They are based on partnerships between public, private and academic sectors, and they have the promise to improve health and well-being, while reducing the burden on health systems by reducing the need for hospitalization. Governments should also provide support for inclusive technologies that benefit people with disabilities.

21. Many participants encouraged scientists, technologists, engineers and innovators to engage with local communities to find accessible and innovative solutions to their public health challenges. All stakeholders should work together to promote policies that lead to the creation and voluntary diffusion of appropriate technologies that will contribute to the achievement of the Sustainable Development Goals. A number of innovations that have great potential in the context of Goal 3 were mentioned during the forum, including a new class of vaccines that do not require refrigeration; the use of patches instead of needles for delivering drugs; a tool to connect female doctors in Pakistan connect with health consumers; and a point system for community medicine deposits that can be used as payment for prescriptions. A major constraint for scaling up such innovations is a lack of

entrepreneurial capacity. This lack of entrepreneurial capacity needs to be dealt with urgently, including by strengthening regulatory environments and putting in place effective intellectual property rights protections.

Science, technology and innovation for achieving gender equality and empowering all women and girls (Goal 5)

22. Gender equality and the empowerment of women and girls is a cross-cutting issue and should be viewed as an accelerator for progress towards achieving all Goals. Gender equality is therefore a foundational element for any meaningful strategy to achieve the Goals. Similarly, progress in science, technology and innovation most often supports gender equality and vice versa, forming a positive feedback loop. Several examples were showcased at the forum — for example, the use of mobile technology by midwives to keep vital records in rural villages in Sri Lanka.

23. Although women have become the majority of new university graduates in most countries, they still account for less than one third of all researchers. Even in countries where women are more strongly represented in science, technology, engineering and mathematics (STEM) education, they lag behind men in the workforce. The lower participation of women in STEM reflects a lower female participation in the work force and occupational segregation by gender in the economy at large. All stakeholders are encouraged to prevent the creation and propagation of stereotypes among boys and girls from an early age at home, to eliminate discrimination and to encourage girls to consider careers in STEM. Stakeholders could promote the visibility of successful women as role models. The United Nations system could showcase women's achievements and contributions in science, technology and innovation for the implementation of the Sustainable Development Goals.

24. Governments should seek to ensure an educational environment that can encourage and prepare girls to participate and succeed in STEM. As leadership is critical, Governments may want to consider supportive actions to improve the role of women as innovators, entrepreneurs and leaders in science, technology and innovation. Governments should promote equal access to resources for women and men in science, technology and innovation, devoting funds to support researchers and entrepreneurs. Governments and the private sector must work to create an enabling environment for gender equality in the workforce, including through parental leave policies, preventing gender bias in the hiring process, combatting gender-based violence and changing cultural perceptions regarding women's role in the workforce.

Science, technology and innovation for conserving and sustainably using the oceans, seas and marine resources for sustainable development (Goal 14)

25. The science-policy interface for oceans should be enhanced. This also requires multidisciplinary approaches and the sharing of data through open data mechanisms to inform decision-making. Such a functioning science-policy interface should demonstrate the full range of the socioeconomic and environmental benefits of the oceans, including in terms of employment and health, and should incentivize private sector participation, building ownership among stakeholders, including youth. Technology can have an impact on the interlinkages between oceans and other Sustainable Development Goal issues, as well as reduce pollution and the impacts of climate change and ocean acidification.

26. Global learning and education on oceans should be enhanced by providing it to young people and future decision makers. Informed citizens and youth can be

involved in developing applied hands-on science, technologies and innovations, including cloud computing, data analytics, the Internet of things and data sharing. International collaboration could be supportive in this regard. One example is science, technology and innovation collaboration on ocean observation based on new technologies to gather data for ocean assessments.

27. Researchers should be connected with the private sector and support young entrepreneurs and citizen scientists. Without proper training these young entrepreneurs and citizen scientists will not have the technical, financial or interpersonal expertise to effectively work toward achieving the relevant Sustainable Development Goal targets. High-impact technologies can offer solutions for a range of ocean-related issues, including solutions for improving fishing practices, pollution clean-up, ocean observations, carbon dioxide storage, and predicting and modelling at scale.

28. Ocean issues are, of course, of particular importance to the small island developing States, many of which are aspiring to transition to a "blue economy". Technology is paramount in such a transition, including technology to connect such States to the outside world and data for harnessing offshore wind, ocean wave and current energy.

Science, technology and innovation for building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation (Goal 9)

29. Multi-stakeholder collaboration on science, technology and innovation should be strengthened at all levels, with a focus on knowledge-sharing and voluntary technology transfer on mutually agreed terms and conditions. Technology can be used to create opportunities for all people, including people with disabilities, to capture the benefits of infrastructure development by voluntarily diffusing and adapting existing technologies. Initiatives are needed that bring together partners from Governments, the private sector and academia, as well as public-private partnerships, with Governments providing an enabling environment and the private sector investing, creating and innovating. New forms of learning, including early information and communications technology education, worldwide student exchanges and new approaches based on games and artificial intelligence, should be explored.

30. Many policy frameworks are available that support innovation, investment, competition and new business models. They realign economics with appropriate incentives, complexity and competition and stimulate research and development investments for the Goals. They coherently bring together supply-side policies and regulations for lowering costs and speeding up deployment with demand-side policies that foster relevance and readiness. Pollution and waste could potentially be reduced through investments in energy- and material-efficient hardware and through the use of cloud computing, as that could reduce the number of lower efficiency devices.

31. There is a need to strike a balance between urban and rural infrastructure investments, in order to create balanced opportunities and access to infrastructure. Continued innovation, the expansion of information and communications technology infrastructure, and innovative business models are essential in all countries. In particular, efforts should be made to make communications bandwidth available at the lowest possible cost. Although the number of people connected to the Internet has grown steadily over past decades, 60 per cent of the world's population are still without an Internet connection and the majority of those connected remain "underconnected". These constraints hamper development, the use of applications and socioeconomic opportunities, according to a survey by Facebook and the Economist Intelligence Unit.

32. Innovators in least developed countries face additional challenges. For example, information and communications technology business models used elsewhere are not necessarily suitable in least-developed countries. The scalability of innovative business models is constrained owing to an absence of financing and small markets, as well as to capacity constraints in knowledge and skills. The "shared economy" approach can lower entry barriers for advanced technology use in poorer countries, especially when built alongside partnerships with major knowledge providers, as illustrated by the Massachusetts Institute of Technology's Fab Lab project.

Lessons learned in improving the impact of science, technology and innovation on the implementation of the Sustainable Development Goals — highlighting the crosscutting nature of science, technology and innovation

33. The synergies and trade-offs between actions under different Goals are non-trivial and underline the cross-cutting nature of science, technology and innovation. Against this background, the 2030 Agenda for Sustainable Development must be understood as an integrated, systemic framework. There is a need for further science-informed analysis of the interactions across the Goals, in order to assist policymakers and practitioners in adopting an integrated approach to implementing the Goals — one which takes into account the positive synergies and potential trade-offs between Goals. While some interactions and interlinkages between the Goals have been analysed, such as in the case of the water-food-energy nexus, a comprehensive overview is still missing, and this continues to constrain integrated policymaking. The recent International Council for Science report entitled "A guide to SDG interactions: from science to implementation" is a first step in this direction. Coherent approaches are also needed to guide research and the identification of relevant science inputs for advancing each of the Goals.

34. Important lessons can be learned from countries' strategic efforts to promote science-policy interfaces and to institute national science advisory systems. Science informs options, but does not automatically make policy, because policymakers must balance many perspectives, including the values of their constituents. Governments and academia should change the way in which they interact with each other, as there is no close collaboration between the two in certain parts of the world. Strong science-policy advisory ecosystems are needed, with a close link between global and national discourse, in order to strengthen evidence-informed decision-making and to optimally leverage science, technology and innovation for the Sustainable Development Goals. The United Nations should take an active role in forging a closer link with national science advisory bodies and should work closely with bodies that provide access to wider networks, such as the International Council for Science and the International Network for Government Science Advice.

35. In today's world, data and information increasingly augment material resources as critical capital for economies. Collecting and securing data in a responsible manner will be critical to solving problems. The opportunities offered by the digital revolution must be understood and exploited in ways that "leave no one behind", as illustrated by the Open Science Platforms for Africa and Latin America, established by the International Council for Science and the Committee on Data for Science and Technology. Multilingual approaches are essential in this regard.

National science, technology and innovation plans and policies for achieving the Sustainable Development Goals

36. The challenge is to design science, technology and innovation policies and instruments for the Sustainable Development Goals that translate the Goals' universality principle into action, while respecting national science, technology and

innovation priorities and realities. A number of lessons have been learned from such national plans, policies and road maps. In particular, it is important to involve all relevant stakeholders and improve science ecosystems. Ownership can be fostered through co-design, co-development and co-production in order to align international responses, including from scientific and engineering communities, with national needs. In many cases, academics and non-governmental organizations have been leading the way.

37. Global partnerships are essential. Science, technology and innovation for the Sustainable Development Goals can serve as a common language, building bridges between various sectors and countries. Strengthened partnerships are needed between the private sector, academia, non-governmental organizations and young people. High-priority actions for these partnerships include global cooperation on human capacity-building and massive data processing and information technology platforms in support of the Goals. Building on corporate social responsibility investments from companies for the implementation of the Goals, a corporate Sustainable Development Goal index should be developed and promoted.

38. Science and technology advisory systems should be engaged in all areas related to the implementation of the Goals and be independent from day-to-day politics. Cross-goal cooperation across sectors should be rewarded and policy instruments operationalized, on the basis of the lessons learned in experimental approaches, such as the green technology bank and model/experimental areas for science, technology and innovation for sustainable development in China.

Science, technology and innovation capacity-building for achieving the Sustainable Development Goals

39. Most countries have development plans that mention the role of science, technology and innovation, and some knowledge infrastructure is in place through institutions and ministries. However, developing countries face a severe lack of capacity in science, technology and innovation systems, infrastructure, trade and investment policy. In addition, despite significant capacity-building efforts, many poor countries fail to make significant progress, as maintaining and retaining newly established capacities remain serious challenges. Against this background, Governments, the United Nations development system and development partners should prioritize open and inclusive capacity-building in science, technology and innovation policymaking, including related policy research, especially on demand-side innovation policies that trigger knowledge use, as well as private sector training. Investors should support comprehensive science, technology and innovation policies that take the Sustainable Development Goals' interlinkages into account.

40. Poverty must be overcome for high-tech capacity to be effectively created and used in poor countries. Poor governance and lack of coordination between science, technology and innovation policy and industrial policy are important challenges in Africa and elsewhere, as government entities often work in silos. Some evidence indicates that companies in Africa learn and innovate through routine activities of production and selling. However, in the changing innovation environment, they must be agile, proactively searching for avenues for innovation.

41. Governments should increase investment in human capital and applied research, promote scientific infrastructure and equipment, and combine data science with broadband communication and connectivity. The digital revolution has created enormous potential for collective scientific advancement, and the need for equal opportunity in the advancement of science is greater than ever. Governments should promote citizen participation in the collection, analysis and sharing of data from all sectors and between all levels, and provide mechanisms for every person in society

to have a voice in planning policies for sustainable development, monitoring implementation of such policies and holding officials accountable for progress. Governments should establish policies that provide access to data and unify data standards, promote open data and support young scientists' initiatives in this regard. The United Nations should support the development of integrated information systems for the Sustainable Development Goals that are based on geographic information system, geospatial technology and geodesign processes. The United Nations should also assist Governments and scientists in building consortiums and data platforms for common sharing and accountability.

Emerging frontiers: evolving science, technology and innovation developments with implications for the Sustainable Development Goals

42. The present era in human history is technologically disruptive due to exponential technological change. This offers both extraordinary opportunities and challenges. In particular, biotechnology, automation technologies, robotics and artificial intelligence, combined with greater connectivity, have a wide range of applications in manufacturing, public and private services, energy, health and agriculture.

43. The precise societal impacts of exponential technological change are not fully understood, but most experts believe it will have profound impacts. Positive benefits might include the unleashing of the creative and collaborative forces of all humanity, leading to higher economic growth and greater wealth; freeing people from repetitive, unfulfilling and dangerous jobs; creating many new forms of employment; and fostering a new economic era of abundance and cooperation rather than scarcity. Negative impacts might include increasing inequalities and inequities; mass unemployment; strain on governance systems; and reduced privacy and freedom despite greater connectivity and an apparent empowerment of civil society.

44. A number of biotechnology areas have the potential to have a significant impact on the Sustainable Development Goals, but require careful analysis in order to maximize benefits and minimize or eliminate negative consequences. These include synthetic biology; improvements in DNA sequencing technologies; high-capacity DNA synthesis; chromosome building; precise editing of DNA (CRISPR); cell-free systems; metagenome and microbiome engineering; tissue engineering (for laboratory-grown organs and meat); improved imaging systems for living organisms, and modelling (virtual cells). These carry the potential to improve crops and livestock; personalize medicine (genome and microbiome); generate new biotherapies (such as immunotherapy and gene therapy); speed up vaccine design and production; conquer disease vectors through genetic modification; produce synthetic replacement organs and biofuel; biomanufacture; and bioremediate.

45. Government policy should guide technological change towards sustainable development, help mitigate the negative effects of such change and promote broad access to the benefits of technology development. Policies should assist developing countries in terms of developing domestic technologies, adapting existing technologies and promoting the diffusion of relevant technical knowledge through the training of new generations of scientists and other capacity-building services. Governments should fund science education and build the internal capacity of the next generation. The private sector also has a positive role to play by building productive capacities in developing countries. Local capacity and appropriate regulatory frameworks are needed if domestic firms are to adopt and adapt foreign technology as well as to develop domestic technologies.

46. The awareness of policymakers should be raised in terms of the potential effects of accelerating technological change, and viable technology strategies should

be elaborated in each country. A group of friends could be convened at the United Nations Headquarters in New York, as proposed by the Government of Mexico, in order to discuss and formulate recommendations to address the impacts of automation and other disruptive exponential technologies.

47. These discussions will continue at United Nations forums such as the General Assembly, the science, technology and innovation forum and other Economic and Social Council forums, and at the regional and national levels. The United Nations Secretariat could present an annual update of the most relevant advances and challenges for societies, economies and the environment. These updates should rely on scientists, economists, academics, businessmen, high-level public officials and other experts, including those from all relevant United Nations agencies, in line with the recommendations of the United Nations expert group meeting on the topic held in December 2016. The United Nations could also assess and help countries to mitigate the potential negative effects of rapid technological change.

Supporting the implementation of the Technology Facilitation Mechanism

48. There is strong demand for the Technology Facilitation Mechanism and its components. Therefore, many participants at the forum called for longer-term funding for the Mechanism at a level that is commensurate with the goal of delivering on the expectations of Member States and other stakeholders. More broadly, funding for science, technology and innovation for the Sustainable Development Goals is crucial. At the same time, the existing funding landscape is highly diverse and fragmented. An annual meeting of public and private science, technology and innovation funders linked to the science, technology and innovation forum could be useful, as proposed in the outcome of an International Council for Science meeting of funders of science and research on 12 May 2017. Domestic resource mobilization efforts should also continue to support international scientific cooperation.

49. The Technology Facilitation Mechanism and the forum should systematically draw on existing efforts of innovation networks in identifying key innovations that could have the potential to foster specific Sustainable Development Goals. Mechanism activities must be closely linked to domestic innovation ecosystems and related stakeholders. The Mechanism's intersessional work should encompass important science, technology and innovation-related events and conferences, in order to amplify the scope of the forum and draw on diverse stakeholder communities, while also facilitating their interlinkages, synergies and mutual support. A road map for the Mechanism that associates key events and activities with the forum throughout the intersessional period and leads to concrete outcomes at each annual meeting is needed.

50. The mapping of United Nations system activities on science, technology and innovation for the Goals presents a rich and diverse landscape of efforts that offer potential for further synergies while recognizing gaps in data, concepts, reporting and strategies across United Nations entities. The United Nations inter-agency task team on science, technology and innovation for the Sustainable Development Goals was encouraged to further refine and update its mapping of science, technology and innovation activities in the United Nations system and beyond, in order to inform discussions in the relevant forums and to guide further efforts at collaboration and capacity-building.

51. The mandated independent assessment of the Technology Facilitation Mechanism online platform has just been completed and is based on an analysis of the experience of 35 existing platforms. It recommends designing the platform around both online and offline components (requiring specialized technical support) to link to brokers/exchanges and countries' mechanisms and build on existing networks. In the

next step, the specification of desired functionalities will be completed and a small set of Sustainable Development Goals, knowledge resources and partnerships will be identified as a starting point, for consideration by Member States. Strong ontologies are needed to enable multilingual content and common protocols for stakeholder interaction. The Technology Facilitation Mechanism platform could explore value-added partnerships with existing initiatives that facilitate matchmaking and brokerage between demand and supply for specific technological solutions. There are several possibilities in both the public and the private sectors. Specific models mentioned during the presentation included the Global Cleantech Cluster Association, the Global Innovation Exchange, the Nordic Innovation Accelerator, the European Union Horizon 2020 programme and related national efforts such as the Green Technology Bank in China and the Digital Bangladesh initiative.

52. There is a further need to strengthen and systematize stakeholder engagement throughout the planning and follow-up of the forum, building on institutionalized mechanisms, including those of the United Nations regional commissions, and strengthened intersessional dialogue in online and offline formats.

Scaling up science, technology and innovation for the Sustainable Development Goals: impact investing and other innovative instruments

53. Scientific research leading to new discoveries and new solutions is only the first step in the process of harnessing science, technology and innovation for the Sustainable Development Goals. The indispensable second step is to deploy the solutions (both new and existing) on a scale that can reach tens of millions, if not hundreds of millions of people, by 2030. For example, deploying 250,000 microgrids could help to achieve Goal 7 on sustainable energy for all. An even greater number of water purification installations will be needed to meet Goal 6 with regard to potable water. Scientists have given us the technical know-how to meet these objectives, and new and improved solutions are likely to continue emerging at an accelerated pace.

54. The challenge is now to deploy the know-how on a scale commensurate with the needs. Meeting this challenge is not a purely scientific problem. Instead, deployment programmes depend on adaptation and social acceptance; supportive regulatory and policy frameworks; appropriate financial instruments; viable business models (including the franchising of social enterprises); entrepreneurs with access to the necessary resources; and mechanisms such as digital platforms, exhibitions and showcases to connect suppliers of appropriate technology with seekers of technology-based solutions.

Exhibition and young innovators

55. As an integral part of the forum, an exhibition hub of innovators was organized, which featured 12 winners of a global call for innovations and a showcase of corporate solutions for the Sustainable Development Goals. Innovations selected from around the world had to be transferrable and inspiring and demonstrate that they make an impact.

56. The exhibition was launched through a special event. Select messages from the launch include: the need for a stronger link between science, society and policy; and closer cooperation between innovators and stakeholders. Science should be made more tangible and accessible, and society should be encouraged to use science wisely. This requires expanding Internet access and building trust with technology beneficiaries. The international community should be more flexible in their procurement processes and in their reporting schedules, so as to facilitate the use of novel technological solutions. At present, there are three areas of disruptive

innovation: physical robots, biotechnology and digital technologies. In all these areas, strong programmes are needed for infrastructure, society, policy, collaboration and trust.

57. A digital transformation showcased by the Microsoft Corporation featured several innovative solutions for the Sustainable Development Goals, including tools for sustainable water management, telemedicine, urban planning and child literacy.

58. The following are short descriptions of the 12 winners of the global call for innovations who pitched their solutions to the forum. Missing Maps is an open, collaborative project to put communities in Haiti, Indonesia and several African countries on the map through crowdsourcing volunteers to digitally map missing areas that are of importance for humanitarian interventions. Ignitia provides highly accurate weather forecasts to small-scale farmers in West Africa via inexpensive text messages. Babajob connects low-income job seekers in India with opportunities relevant to them and employers with the right candidates in the informal sector in an online marketplace. Virtual Farmers Market is an app-based e-commerce platform in Zambia where farmers' surplus and buyers' demand for crops are advertised and traded. doctHERs is a digital health platform that connects remotely located (home-based) female doctors in Pakistan to underserved health consumers in need of quality health care via nurse-assisted video consultation. The Virtual Water Prospecting Program employs an advanced artificial-intelligence-based technology to carry out virtual water prospecting for underground rivers in India that are salt-free. Farmer Query System includes a mobile-based app that enables farmers in Bangladesh to place queries related to agricultural problems to an urban agriculture expert through a government agricultural extension agent or information intermediaries. OMOMI is a mother's health app and Internet and text messaging service based on the World Health Organization's childhood survival strategies, which helps mothers in Nigeria to track immunization and monitor the growth and development of their children. Mobilized Construction is a technology company that is disrupting the way dirt roads are built, monitored and maintained across Kenya by using a software platform facilitating labour-based road construction. Paper Airplanes is a digital solution to refugee education access that provides personalized tutoring through Skype, matching refugee students predominantly in the Middle East and North Africa region with personal tutors. JokkoSante is a disruptive circular economy model in which medicine deposits in the community pharmacy are rewarded by points that can be used later to pay for a new prescription through a trusted mobile platform in Senegal. CodePhil aims to teach, empower and connect the youth in Northern Samar, Philippines, through digital literacy skills such as typing, computing and programming, with the ultimate goal of enabling decent jobs for youth and community resilience.

Side event highlights

59. Stakeholders organized 25 side events on a broad range of science, technology and innovation for issues related to the Sustainable Development Goal. Selected conclusions from these events include the following.

60. Recent innovations in the technology frontier of manufacturing pose a serious challenge to all countries, but especially developing countries. As the gap between the slowest and fastest industrializing countries continues to widen, the United Nations system should facilitate the transfer and use of advanced technology to the technologically weakest countries.

61. Scientists must better understand policy and policymaking processes. A diversity of scientists — both young and old — must be incentivized and mobilized to support evidence-based policymaking.

62. Governments should acknowledge in their national plans the potential of science, technology, innovation and artificial intelligence in terms of bridging gaps in all aspects of the Goals, including mental health, well-being and resilience, following the examples of Lebanon and Sierra Leone. Partnerships on Goal 17 involving Governments, civil society and the private sector on the use of artificial intelligence and other technologies in mental health and well-being services are needed.

63. Partnerships between all stakeholders are needed to spur innovation and produce demand for broadband Internet. Multi-stakeholder collaborative processes are needed for the generation of locally relevant content of scientific, commercial and cultural value in local languages. The continued adoption of internationalized domain names will also be important for connecting the next billions of Internet users.

64. A continued discussion is needed on the role of science, engineering and technology for smart, sustainable cities, which would lead to a checklist and guidelines for smart cities, peri-urban areas and rural areas, in line with the Goal aspirations.

65. At present, most meteorological observation networks around the world are incapable of providing weather measurements suitable for precision agriculture. Precise information about weather, crops and farming operations can help to increase food production. Partnerships between Governments, the United Nations system, the private sector, civil society and academia can promote the scaling up of such applications.

Online discussions and other contributions

66. In preparation for the science, technology and innovation forum, the United Nations inter-agency task team on science, technology and innovation for the Sustainable Development Goals and the 10-member group conducted online discussions, in order to allow wider participation by experts and interested laypersons worldwide. Selected recommendations from these discussions are summarized below.

67. The adaptation and social acceptance of technologies is of paramount importance in order to connect with specific local economies, ecosystems and sociocultural settings and to ensure technology diffusion. Equal attention should be given to "hard" and "soft" technologies, recognizing that they are closely intertwined. Similarly, understanding of technology should not be limited simply to digital technology. Low-tech solutions and social innovations are important. "Frugal innovation", which refers to technologies of reduced complexity and cost, for the implementation of the Sustainable Development Goals can help in integrating the "bottom of the pyramid" worldwide.

68. Science, technology and innovation ecosystems are complex institutional systems. Their effectiveness depends on good governance, institutional effectiveness, rule of law and effective frameworks for the protection of intellectual property rights and on investment in infrastructure, research and development, and human and institutional capacities. The entire educational system — from primary to tertiary education — must foster creativity in students, inter alia by teaching competence-based problem-solving skills, in order to strengthen innovation systems.

69. National science, technology and innovation plans and policies should be conceived and designed in an open and inclusive manner, building on the diverse expertise and knowledge of stakeholders. Academies of science and related organized science groups should be encouraged to take an active role in national science, technology and innovation policy processes and in identifying needs and gaps. Effective science-policy interfaces are crucial for informed policymaking. The

United Nations system should strengthen such interfaces, building trust between science and politics.

III. Key messages and general recommendations

70. The forum highlighted many practical examples and proposed important recommendations for action by the United Nations system, Governments, businesses, scientists, civil society and others. The necessity of a multi-stakeholder approach was repeatedly underscored. The following issues stand out and are suggested for consideration by decision makers.

Strategies, approaches and road maps

71. The cross-cutting nature of the Sustainable Development Goals (their interdependencies, potential trade-offs and synergies) and of science, technology and innovation requires holistic approaches and strategies. In this context, multidisciplinary and integrated approaches are necessary to take into account different sources of knowledge (including traditional knowledge). Recent large-scale disease outbreaks are a case in point, as early warnings have been made more difficult by institutional silos between animal health monitoring and human epidemiology.

72. Science, technology and innovation road maps and action plans that have a particular focus on accelerating progress towards the Goals are essential. They are needed at the subnational, national and global levels, and should include measures for tracking progress. These road maps incorporate processes that require feedback loops, evaluate what is working and not working, and produce continual revisions that create a real learning environment. They are most effective if built up with stakeholder engagement and when they contribute to "smart Government".

73. "Deep dives" are needed for each Goal for which road maps could help prioritize actions and promote cross-sectoral collaborations, as was illustrated by the forum's dedicated sessions on Goals 1, 2, 3, 5, 9 and 14.

Low-cost technology and meeting basic needs

74. There is a need to pay more attention to meeting needs through existing low-cost technologies. This requires scientists and innovators to engage with the realities of local communities. For example, the needs of small-scale farmers should be put at the centre of agricultural innovation systems.

75. Many examples of low-cost technologies exist, while others can be developed. These should be shared, adapted as needed and deployed, in order to ensure the widest possible diffusion and dissemination of benefits, especially for the poor and those at risk of being left behind. The forum provided many illustrations of this point, with examples of the impacts of local technology initiatives, such as Gearbox in Kenya and the production of small-scale refrigerators in India.

Inclusiveness and stakeholder engagement

76. All relevant stakeholders should be engaged in science, technology and innovation policy design, adaptation and application. Collaboration should be fostered among scientists, engineers, companies and the end users of technological products. The practical usefulness of inclusiveness was highlighted, with many examples presented at the forum, including for poverty eradication, vaccine development and science, technology and innovation strategies for food security.

77. Gender differences in terms of access to and the use and impacts of technologies arise through many different mechanisms, including those related to social and cultural factors. A multi-pronged approach is needed to address them. One important aspect is building the capacity and engagement of girls and women in science, technology, engineering and mathematics. At the same time, there should also be social and organizational support for women to pursue careers in these areas, including as innovators and entrepreneurs.

Investment, Governments and the private sector

78. Public-private partnerships are essential for science, technology and innovation, as are other efforts that expand partnerships with the private sector for creating business opportunities in pursuing science, technology and innovation solutions to the Sustainable Development Goals. Regardless of the model of involvement, a business case should be made for private sector investment in innovation for the Goals. Member States were also called upon to support the Technology Facilitation Mechanism, both politically and financially.

79. Strategies on fostering start-ups can be useful for crowdsourcing solutions to both economic and daily life challenges. In fact, existing technologies can solve many current needs, if matchmaking and scaling up can be facilitated, as was demonstrated in the forum's exhibitions and event on deploying, financing and scaling technologies.

80. There is a need to scale up smart investment by Governments, the private sector and other partners, including for building productive and human capacity for science, technology and innovation to unlock the creative potential of youth and women. Investments in infrastructure and connectivity to bridge various forms of exclusion, including rural-urban and geographic divides, are particularly important, in view of the centrality of information and communications technology infrastructure expansion to science, technology and innovation and development efforts. Efforts could also be made to scale up science, technology and innovation through new and innovative solutions, financial instruments and channels such as impact investing, crowd-funding, diaspora funders and local communities.

Productive capacities, innovation and emerging technologies

81. Science, technology and innovation capacity-building in every country is essential. This includes building human and institutional capacity and strengthening science advisory ecosystems and science, technology and innovation policy. Governments have an important role to play in creating incentives for building productive capacities, as evidenced by the success of development driven by science, technology and innovation in many Asian countries. As innovation happens across the world using a variety of technologies, the dissemination of such technologies must be encouraged, including through partnerships and the sharing of experiences.

82. In a rapidly changing world, foresight in science, technology and innovation is needed to understand the potential opportunities and challenges associated with advancing science and technology. There are positive and negative impacts from the disruptive effects on societies of new technologies, such as nanotechnology, automation, robotics, artificial intelligence, gene editing, big data and 3D printing. The future cannot be predicted, but understanding the possible consequences of decisions taken now is essential. In this context, there is a need to broaden discussions on the impact of technologies and science in general.

IV. Recommendations for the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

83. Going forward, the forum will continue to provide opportunities to strengthen dialogue between stakeholders and Governments and to promote an environment conducive to sharing and exchanging ideas and success stories and catalysing new initiatives and partnerships. It will continue to help to identify practical means and solutions to foster science, technology and innovation in all countries. In that respect, the forum should consider including discussions of various sources of knowledge in future iterations of the forum and continue to facilitate exchanges on science, technology and innovation solutions. The forum should also continue to serve as a venue to provide specific, practical guidance on how to make science, technology and innovation for the implementation of the Sustainable Development Goals a reality.

Supporting and sustaining the Technology Facilitation Mechanism

84. The high participation and engagement levels from a very diverse cross section of relevant parties showed that there is a real demand for the multi-stakeholder forum to focus on science, technology and innovation for the Sustainable Development Goals. Participants, including Member States, stressed the need to strengthen the science-policy interface in order to maximize the contribution of science, technology and innovation to the Goals.

85. Given the high expectations for the Technology Facilitation Mechanism to deliver concrete advice and guidance on issues related to science, technology and innovation, Member States should consider strengthening their political and financial support for the Mechanism. In particular, support is needed for even greater participation in the forum from developing countries and the development and operationalization of the Mechanism, including both its online and offline activities. In order to make the most effective use of limited resources, the Mechanism and the forum should draw more systematically on existing efforts of innovation networks in identifying key innovations with a high potential for impact on the realization of specific Sustainable Development Goals. Mechanism partnerships should be explored and formalized with research funding agencies, foundations and development agencies.

Road map for the Technology Facilitation Mechanism and intersessional work: connecting with the sessions of the high-level political forum

86. A road map for the Technology Facilitation Mechanism should be developed by the inter-agency task team and the 10-member group. The road map should also include details on instituting intersessional work, including on means and ways to associate key international events and meetings with the forum, in order to maximize the impact of the forum and to draw on key messages from different stakeholder communities. Examples of meetings that were referred to in the forum include the Commission on Science and Technology for Development, the World Government Summit, the Global Science, Technology and Innovation Conference, the Global Solutions Summit, meetings of the International Network of Government Science Advice, various regional United Nations meetings, and expert group meetings focused on key emerging technology issues.

87. The forum should be action-oriented and cumulative in its impact, including in the messages it provides to the high-level political forum. Over the coming 13 years, future forums should learn from and advance the achievements of previous

ones. The forum should become the outcome of an annual programme of results-oriented activities and, as part of a series, provide a regular opportunity to collaboratively define priorities for action. The 10-member group and the inter-agency task team should further refine those objectives and develop specific actions to support those objectives.

The forum as a catalyst for multi-stakeholder partnerships

88. Governments should collaborate and innovate with all types of stakeholders and experts to leverage the potential of science, technology and innovation to achieve the Goals. In this context, the United Nations should continue to support such cooperation through its convening power. In particular, the forum should serve as catalyst for multi-stakeholder partnerships that include the private sector. It should be closely linked with and foster collaboration across existing initiatives, as well as mobilize new partnerships at the national, regional and global levels. In view of the increased participation and interest, and to promote stakeholders' ownership of the forum, future forums should consider a larger number of thematic breakout sessions and events that could perhaps report to plenary sessions.

Systematically filling gaps in capacity-building by the United Nations system

89. The mapping of United Nations system activities on science, technology and innovation for the Goals conducted by the inter-agency task team and presented at the forum highlighted a number of significant activities, as well as gaps in terms of resources, strategic focus, data and reporting. The United Nations system and its Technology Facilitation Mechanism partners should work together to systematically close these gaps and increase their joint impact. In particular, the Mechanism may need to focus on matchmaking between existing problems and existing solutions and facilitate science, technology and innovation assistance to countries, where it is most needed. In this context, other steps may be considered for strengthening the United Nations support to science advisory ecosystems and for facilitating greater synergy and collaboration across the agencies in the inter-agency task team. The mapping of activities should be refined and as needed, in order to support well-informed discussions at forums in the coming years.

The forum to address the challenges of emerging technologies

90. The Technology Facilitation Mechanism should support or conduct forward looking exercises on emerging developments in the field of science, technology and innovation so as to make deliberations on emerging technologies a regular feature at each forum. Given the potential of these developments to have a significant impact on human well-being and sustainability around the world, a longer-term and systematic programme of work in a multi-stakeholder format would help illuminate issues and provide guidance at various levels. In this context, the creation of a group of friends among United Nations missions in New York, as suggested by the Government of Mexico, could move forward discussions on these topics.